URBAN SECURITY
A COMPETENCY DEVELOPMENT THRUST

SUMMARY: The security of the United States is recognized to be inextricably linked to the health and well-being of our national infrastructure (President's Commission on Critical Infrastructure Protection, 1997). The national infrastructure comprises highly complex and non-linear feedback links between transportation, communications, power, financial, and natural systems. At the core of these linked systems are cities. Because of rapid urbanization, the decay of infrastructure, the possibility of economic and information warfare, terrorist attacks, and natural disasters, a detailed understanding of how cities function is vital for an assessment of their vulnerabilities—including responses to crisis situations, and planning for sustainable growth and infrastructure development. The traditional approach for making these assessments, either by modeling individual sub-systems or by linking highly simplified models, is inadequate to describe the complex behavior of cities.

Our goal is to develop a cross-divisional complex systems competency at Los Alamos to assess the response of urban systems to changes in the physical environment, socio-political setting, and the economy. Complex systems research applied to urban security is important to the near-term needs of the DOE and LANL programs in support of national security and counterproliferation. This competency will also support the long-term needs of the DOE and secure future LANL capabilities in energy research, environmental management, environmental security and infrastructure protection.* The Laboratory, in its vision statement, has made a commitment to "..pursuing solutions to global security, quality of life, and preservation of the Earth" (1996). The Urban Security competency development will build on modeling strengths developed by the Laboratory in both the weapons and environmental programs of the last few decades and define a new area of Laboratory expertise in multi-scale cross-disciplinary integrated modeling. A competency and integrated modeling capability in urban systems will position the Laboratory to be in the forefront in national security, environmental sustainability, and infrastructure issues.

Our research efforts will concentrate on creating a science-based modeling framework for predicting the vulnerability of urban systems to malicious attacks, natural hazards, natural resource shortages, and environmental degradation and for mitigating the negative consequences. The modeling framework will be composed of many state-of-the-art sub-system models for simulating traffic flow, energy distribution, air and sub-surface fluid dynamics and chemistry, communications, and other natural systems, which are intimately linked through "interface" sub-models that communicate with decision-making tools. Significant and innovative research efforts into the interface sub-models will be required since the problem embraces very different "process" phenomena, involves significant feedback mechanics, and encompasses physical systems over a broad range of scales (from mm's to km's). LANL-developed models will need to be reassessed because of scaling, abstraction, and fidelity issues and must be adapted to high performance computing (HPC) platforms to handle the scope of the problem.

In the first two years of the project, we will focus our work on three well-defined problems chosen to encompass a large number of subsystem models, to stress the interface physics development, and to hasten the design of an architectural framework for the system components. The three problems, which will be described more fully in the main body, include: 1) an air, water, and transportation interface scenario, 2) a natural hazards, structural response, energy, transportation, and communications simulation, and 3) a system integrating physical science, economic, and decision-making tools and protoyping a Graphical User Interface (GUI) tool kit for the end-user. The nature and scope of the problem will require concerted research efforts into the physics of interfaces and test the capabilities of LANL's high performance computing facilities. The integrated nature of the modeling framework will test the efficacy of the "whole being greater than the sum of the parts."

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* The Urban Security CD thrust supports core competencies in Analysis and Assessment, Theory, Modeling, and High-Performance Computing, and Earth and Environmental Systems, and components of the EM, DoD, and NIS (remote sensing and NBC components) Program Offices.